esade

TEACHING GUIDE - 2025-2026

Financial Econometrics

UGRA_015703

Departments	Department of Economics, Finance & Accounting
Teaching Languages	English
ECTS	4
Teacher responsible	Vladimir Manaev - vladimir.manaev@esade.edu Omar Rachedi - omar.rachedi@esade.edu

Course Goals

Course Objectives:

The course aims to equip students with advanced tools for modeling and forecasting financial risks using modern econometric techniques. It emphasizes both theoretical understanding and practical application in R. Students will learn to analyze financial time series, forecast volatility, assess extreme risks, model nonlinear dependence, and optimize risk-aware portfolios. The course integrates classical models (ARMA, GARCH), Extreme Value Theory (EVT), copulas, and machine learning to address real-world challenges in portfolio management, risk measurement, and forecasting.

Previous knowledge

Students are expected to be familiar with basic econometrics and statistics (regression, hypothesis testing), introductory probability theory, and basic financial concepts (returns, volatility, risk measures). Prior exposure to time series analysis is helpful but not required. Familiarity with R or another programming language is advantageous.

Prerequisits

General familiarity with stock markets would be beneficial, but not necessary.

Recomended courses

No previous courses are required, but Introduction to Statistics and Probability would be helpful.

Teaching methodology

The course is highly applied and project-based. Each session combines theoretical lectures with interactive coding in R. Students will work through practical exercises using real financial data, progressively building a full risk modeling and forecasting pipeline. The final sessions include a forecasting competition (capstone project) where students apply all learned techniques. The course emphasizes collaborative learning, peer feedback, and the development of clear communication skills for conveying complex financial analysis.

Description

Course contribution to program

This course contributes to the BBA program by enhancing students' quantitative and analytical skills, which are essential for modern business decision-making in financial markets and corporate risk management. It provides a rigorous foundation in financial econometrics, enabling students to analyze, model, and forecast complex financial data—skills that are increasingly demanded across investment firms, banks, fintech companies, consulting, and corporate finance departments.

Through its hands-on, project-based approach, the course fosters data-driven thinking, critical analysis, and clear communication of financial insights. It complements core areas of the BBA program—such as Finance, Strategy, and Data Analytics—by equipping students with advanced tools for portfolio management, risk assessment, and strategic financial decision-making. Moreover, the final capstone project encourages teamwork, creativity, and applied problem-solving, further reinforcing the program's focus on practical business competencies.

Short description

This course introduces students to modern financial econometrics, with a focus on modeling and forecasting risk in financial markets. It covers key tools such as ARMA and GARCH models, Extreme Value Theory, and copulas, and integrates machine learning techniques for risk forecasting. The course emphasizes hands-on application using R and real financial data, preparing students to tackle challenges in portfolio management, risk assessment, and financial decision-making. A final capstone project allows students to apply the full risk modeling pipeline in practice.

Bibliography

J.M. Wooldridge, Introductory Econometrics: A Modern Approach, 7/e, Cengage, 2020 (Book)
Brooks, C., Introductory Econometrics for Finance, 4th ed. Cambridge University Press. (Book)

Activities

Group presentations
Practical group project: Forecasting the Volatility of Stock Return Volatilities

Readings
Lectures.

Case study analyses
R Labs

Content

#	Topic
1	Econometrics Toolbox: Intro to R. Financial Data Handling and Visualization. Intro to R and RStudio. Financial data structures (xts, zoo, quantmod). Downloading and cleaning financial data. Calculating returns. Visualizing prices, returns, and volatility.
2	Stylized Facts of Financial Returns. Stationarity and Diagnostics. Volatility clustering, heavy tails, skewness, leverage effect. ACF, QQ plots, return histograms. Stationarity vs unit roots (ADF/KPSS tests). Simulating fat-tailed vs normal distributions.
3	Time Series Analysis: AR and MA Models. Forecasting Returns. AR(p), MA(q), ARMA(p,q) models. Model identification (ACF/PACF), estimation, residual diagnostics. Forecasting returns and constructing confidence intervals.
4	Modeling and Forecasting Volatility: ARCH and GARCH Models. ARCH(q), GARCH(1,1), asymmetric models (GJR-GARCH, EGARCH). Conditional heteroskedasticity and volatility forecasting. Introduction to Value-at-Risk from GARCH.
5	Extreme Value Theory (EVT): Modeling Tail Risk. Block Maxima and Generalized Extreme Value (GEV). Peaks Over Threshold (POT) and GPD. Estimating tail index, VaR and Expected Shortfall from EVT. Comparison with GARCH-based risk measures
6	Copulas for Nonlinear Dependence and Joint Risk Modeling. Limitations of correlation. Gaussian, t, Clayton, Gumbel copulas. Fitting marginals (GARCH + EVT), estimating copulas, simulating joint distributions. Tail dependence and joint risk.
7	Integrated Risk Modeling: GARCH + EVT + Copula Pipeline. Combining volatility, tail, and dependence modeling. Forecasting portfolio VaR and ES using hybrid models. Monte Carlo simulation. Backtesting forecasts with Kupiec and Christoffersen tests.
8	Portfolio Optimization under Risk Constraints. Mean-variance optimization and efficient frontier. Incorporating forecasted volatility, VaR, and ES. Long-only constraints. Comparing performance under different risk-based objectives.
9	Machine Learning for Financial Forecasting. Ridge and Lasso regression. Forecasting returns, volatility, or VaR with multiple predictors. Cross-validation, model selection, and comparison with classical econometrics.
10	Forecasting Challenge: Capstone Project. Students work in teams to forecast returns and risk measures on a basket of assets. Apply full pipeline (ARMA, GARCH, EVT, Copula, ML). Backtesting, peer review, and final presentation.

Assessment

Tool	Assessment tool	Category	Weight %
Written and/or oral exams	Final Written Exam (50%)	Retake and ordinary round	50.00%
Group project	Group Project: Forecasting Portfolio Volatilities	Retake and ordinary round	40.00%
Participation in program activities	Participation in class	Retake and ordinary round	10.00%

PROGRAMS

- BBA20-Bachelor of Business Administration (BBA) (Undergraduates: Business)
  - BBA20 Year 2 (Optative)
- BBA23-Bachelor of Business Administration (BBA) (Undergraduates: Business)
  - BBA23 Year 2 (Optative)
- DBAI23-Double Degree in Business Administration and Artificial Intelligence for Business (Undergraduates: Business)
  - DBAI23 Year 1 (Optative)
  - DBAI23 Year 3 (Optative)
- GBD20-Double Degree in Business Administration and Law (Undergraduates: Law)
  - GBD20 Year 4 (Optative)
  - GBD20 Year 1 (Optative)
  - GBD20 Year 5 (Optative)
  - GBD20 Year 3 (Optative)
  - GBD20 Year 2 (Optative)
- GBD23-Double Degree in Business Administration and Law (Undergraduates: Law)
  - GBD23 Year 1 (Optative)
  - GBD23 Year 5 (Optative)
  - GBD23 Year 3 (Optative)
  - GBD23 Year 2 (Optative)
  - GBD23 Year 4 (Optative)